

**Chemical &
Engineering**

NEWS

7/ A1250-1

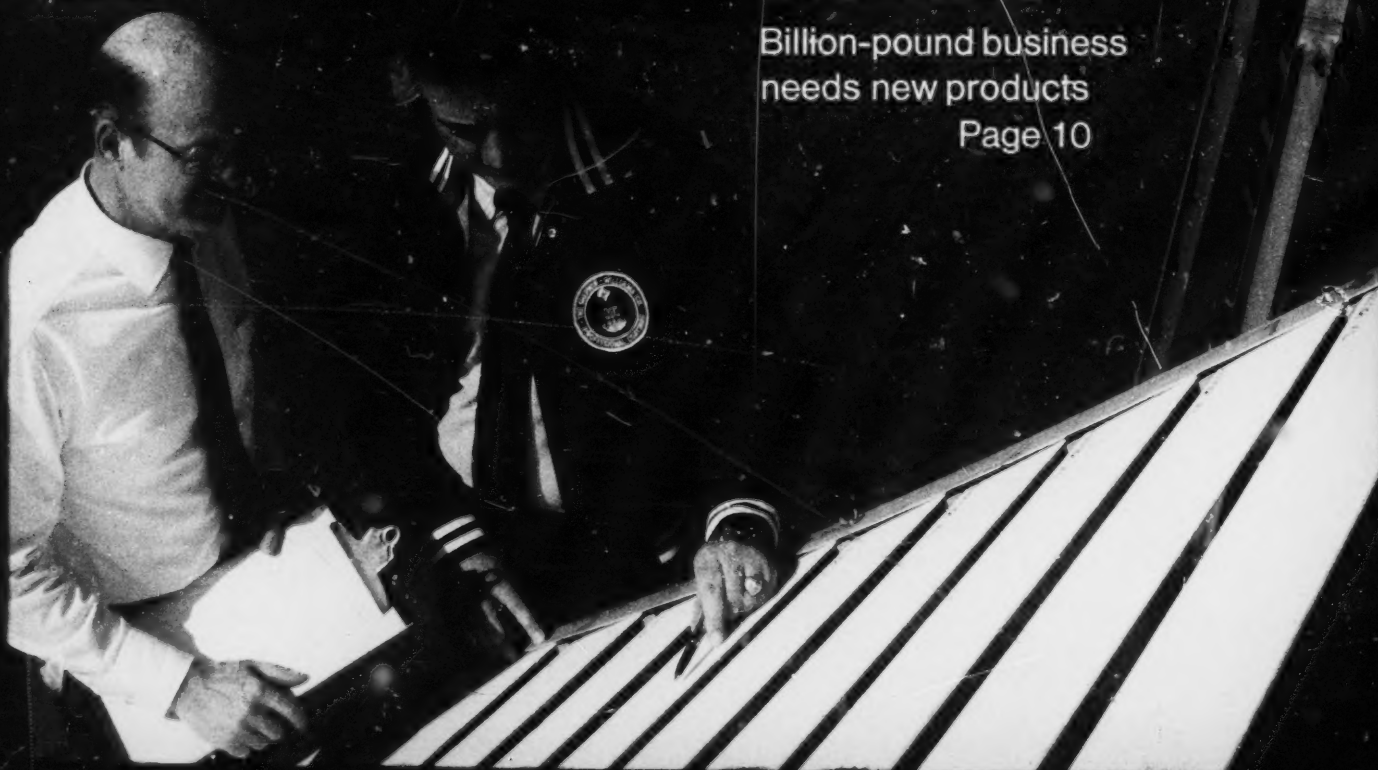
4/12/82

0511179C092 9 M AR6015SL 1
CONGRESSIONAL INFO SERV
4520 EAST WEST HWY SUITE 800
BETHESDA MD 20814

Industrial biocides

Billion-pound business
needs new products

Page 10



Cover: Joint fungicide development brings together William M. Lewis of Diamond Shamrock and Steve Brotzman of Sherwin-Williams at southern Florida coatings test facility

4	Letters
	Concentrates
9	Business
15	Government
23	Science/Technology

	The Departments
67	Meeting Briefs
70	New Products
77	Meetings
82	People
92	Newsprints

News of the Week

- **Chemical stocks have fallen on hard times**—they have been declining even faster than the stock market as a whole and their outlook isn't very good. **Page 6**
- **National minerals policy** released recently by the Administration aims at higher production of minerals and a beefed-up stockpile of critical materials. **Page 7**
- **Air cleanup "bubble policy"** has been expanded by EPA into more flexible program to speed up attainment of national air quality standards. **Page 7**
- **Foundation has been formed** to support research and training in the life sciences at the postdoctoral level. **Page 7**

Business

- **Industrial biocide makers** are squeezed by threat of government standards to develop new products that may not be accepted if the price is too high. **Page 10**

International

- **Canadian chemical industry** cuts production, delays or cancels construction plans to alleviate effects of recession. **Page 14**

Government

- **Symposium** reports universities seek industry R&D support, NSF commission to study high school science teaching. **Page 16**

Science

- **From the ACS meeting:** new drugs control gastric acid secretion; computer system to search chemical reactions; muonium atoms and initiation kinetics; analogy bridges organic, inorganic chemistry. **Page 24**
- **Molecular lanthanide and yttrium hydride complexes** synthesized. **Page 32**

Education

- **Educators should teach more scientifically**, include problem solving in coursework, symposium attendees conclude. **Page 35**

ACS Annual Report

Highlights of the society's activities in 1981 include gain in membership, plans to construct new building. **Page 37**

Technology

- **New waste recycling processes** from Europe convert plastics and tires to gas, tires to oil, paper to oil. **Page 58**
- **From Las Vegas:** two new shale oil processes set for commercialization; advances in hydrogen manufacture. **Page 60**

ACS News

- **Camera catches meeting-goers** amid the neon of Las Vegas. **Page 74**

CHEMICAL STOCKS SLIP SHARPLY

It has not been a good season for investors in chemical stocks. Although the stock market has been declining over the past several months, stocks of chemical companies have declined even faster. And the outlook for chemical stocks may not be as good as for some other industries. In short, chemical companies are in the doghouse on Wall Street.

In the past three months, C&EN's chemical company stock index has dropped 8.4% to 185 (1954 = 100) from 202 at the end of 1981. The chemical stock index is based on stock prices of Allied Corp., American Cyanamid, Celanese, Dow Chemical, Du Pont, Monsanto, and Union Carbide. The index is weighted according to the number of outstanding shares for each company.

By contrast, broader measures of the stock market have not fared so badly in the past quarter. Probably the most widely quoted stock market indicator, the Dow Jones Industrial average, has fallen just 4.1% to 839 from a year-end index of 875.

The biggest drop through the quarter has been the American Stock Exchange index, which has fallen 17.4% to 265 since the end of 1981. However, the Amex index is dominated by oil stocks, which have fallen into even more disfavor than chemicals since the beginning of the current oil glut.

The only other major overall index to perform worse than chemicals in the past three months has been the National Association of Security Dealers Automated Quotation system (NASDAQ), the over-the-counter industrial average for small companies. This index dropped 11.4% since the end of 1981 to 203.

A year ago, the stock market was in fairly healthy shape with the Dow Jones Industrial average above 1000. And, of course, the fall in the past year is greater than in the past three months. But only the Amex index has fallen faster than chemicals in the past 12 months. In the past year, the C&EN stock index has dropped about 27% to its current 185 from 254 a year ago. The Amex index is down 28% from last year. By contrast, the Dow Jones Industrial average has fallen not quite 17% from 1007 a year ago.

Almost all of the chemical stocks making up the C&EN index were near their 12-month highs a year ago, so that the drop from the yearly high is almost the same as the drop from 12 months ago.

Allied Corp., with its heavy earnings influence from oil operations, has suffered the worst drop of the chemical companies. On Friday, April 2 (the date taken as the end of the quarter since it is the Friday immediately after the quarter ended), Allied's stock closed at \$33.25,

down about 37% from its stock price a year ago and down almost 45% from its yearly high of \$59.875.

The stock price at Dow Chemical has fallen nearly 35% to \$23.625 from its price a year ago and 39% from its yearly high.

Du Pont, which has generated a lot of criticism on Wall Street because of its takeover of Conoco, also has suffered a big stock price decline. Du Pont's stock price has fallen about 31% to \$35 from a year ago and is almost 38% below its 12-month high of \$56.

The best performer of the seven chemical companies making up the index was Monsanto, whose stock price has fallen not quite 12% to \$64.375 from a year ago. It is, however, down 26% from its yearly high of \$87.50.

The stock price for Celanese is down 17% to \$55.25 from a year ago and off 20% from its high. American Cyanamid's stock price is down 20% to \$27.375 from a year ago and down 25% from its \$36.50 high. And Union Carbide's stock price is down 20% from a year ago to \$48 and off almost 23% from its yearly high.

C&EN's chemical stock index hit its low on March 17 this year at 171 and has risen 8.2% since then to 185. However, whether this is a true turnaround in the stock, or merely a temporary increase remains to be seen. □

Chemical stock averages have performed worse than most others

	Closing average					Quarterly per cent change				Annual change April 3, 1981- April 2, 1982
	April 2, 1982	Dec. 31, 1981	Oct. 2, 1981	July 2, 1981	April 3, 1981	April 2, 1982	Dec. 31, 1981	Oct. 2, 1981	July 2, 1981	
C&EN Stock Index*	185.0	202.0	199.0	250.0	254.0	-8.4%	1.5%	-20.4%	-1.6%	-27.2
Dow Jones 65 stocks average	326.84	347.80	337.22	372.41	395.96	-5.5	3.1	-9.5	-6.0	-17.0
Dow Jones Industrials average	838.57	875.00	860.73	959.19	1007.11	-4.1	1.7	-10.3	-4.8	-16.7
New York Stock Exchange composite	66.22	71.11	68.80	74.73	78.14	-6.9	3.4	-7.9	-4.4	-15.3
New York Stock Exchange Industrials	74.68	80.89	78.47	86.24	91.40	-7.7	3.1	-9.0	-5.6	-18.3
American Stock Exchange index	264.66	320.63	307.67	366.84	369.13	-17.4	4.2	-16.1	-0.6	-29.2
Over-the-counter composite	178.56	195.84	184.37	212.80	212.65	-8.8	6.2	-13.4	0.1	-16.0
Over-the-counter Industrials	203.05	229.29	219.04	261.22	263.34	-11.4	4.7	-16.1	-2.7	-24.3
Standard & Poor's 500 stock average	115.12	122.55	119.36	128.64	135.49	-6.1	2.7	-7.2	-5.1	-15.0
Standard & Poor's 400 Industrials average	127.90	137.12	133.77	144.67	153.56	-6.7	2.5	-7.5	-5.8	-16.7

* Weighted stock price index of Allied Corp., American Cyanamid, Celanese, Dow Chemical, Du Pont, Monsanto, and Union Carbide; weighted according to number of shares outstanding for each company. 1954 = 100.

New biocides find acceptance difficult

Low prices of traditional products stifle innovation, inhibit switch to more costly, safer biocides that meet government standards

Patricia L. Layman
C&EN, New York

Manufacturers of industrial biocides are caught between a rock and a hard place. If they develop new products that are acceptable to the government on safety grounds, they may find that the products will not make it in the marketplace because of higher prices. If they stick with the older, lower-priced products, the government is going to take a dim view of those products.

For biocides makers, current troubles date back to the early 1970s, when legislative fervor began mounting against the mercurial compounds used in a host of applications. These troubles continued and intensified into the 1980s, as other favorite products—phenolics and formaldehyde—in turn came under fire. Complicating matters, the materials haven't been banned in all

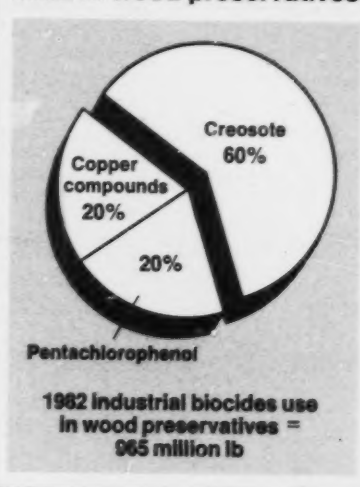
cases—only thrown under a cloud of suspicion.

So manufacturers of biocides are in a quandary. Many potential customers for new products won't abandon their old standbys, particularly because these materials tend to be both effective and low in cost. Meanwhile, customers who have switched to hopefully safer materials are looking for ever-better materials to justify higher prices. But manufacturers, by and large, can't justify the massive amounts of time and money required for completely new synthesis work. So new biocidal materials are almost incidental spinoffs from pharmaceutical and agricultural chemical technology.

The major problem is the size of the biocides business—or rather, the relative lack of size. Although on a sheer poundage basis it is a more than 1 billion lb-per-year business, it is dominated by low-priced commodity wood preservatives, which pull down manufacturers' dollar value to probably about \$550 million this year.

And biocides are a fragmented business. When it completed a study on biocides in 1979, C. H. Kline & Co., a Fairfield, N.J.-based consulting company, noted that there were 19 suppliers each with sales of biocides of more than \$5 million, and 40 with sales of more than \$1 million. Manu-

Creosote is major biocide used in wood preservatives



facturers' sales in the U.S. at the time were about \$360 million, Kline estimated.

The fragmentation by company and by product application has limited the size of the commitment many companies can give to new biocides. Obtaining approval for a new biocide doesn't reach the same levels, of course, as the nearly \$10 million and 10 years by one estimate that it takes to get a new agricultural chemical or pharmaceutical product approved by government agencies—but it is not tremendously less. And whereas agricultural chemicals and pharmaceuticals often offer the potential of a multimillion-dollar market, a worthwhile sales volume for a biocide is probably under \$10 million per year. So it becomes difficult for a biocide maker to justify the time and expense for new materials.

That primarily explains the scarcity of new products coming to market. The latest, a brominated dicyanobutane, from Merck, was identified during a screening of pharmaceuticals and pharmaceutical intermediates (C&EN, Feb. 1, page 17). And most people in the industry expect that in the future, new biocides will come from similar work—pharmaceutical or agricultural chemical work in which some alert researcher notes properties in a

Biocides tend to concentrate on specific markets

Biocides	Disinfectants and sanitizers	Paints	Hospital products	Wood preservatives	Cooling water systems	Paper	Plastics and resins	Petroleum	Metalworking
Halogens									
Phenolics									
Quaternaries									
Organosulfurs									
Inorganics									
Organometallics									
Nitrogen compounds									

Source: C. H. Kline & Co.

compound that might be good for biocides. That suggests that companies with strong biocide interests probably also will have strength in either of the other two areas, as well, in the future.

That's true in the U.S. and it is also true in Europe, according to James R. Hickey, general manager of C. H. Kline's European operations in Brussels. Hickey, who is launching a series of studies on biocides markets in Europe, predicts a shakeout of producers of biocides, with companies with limited product lines and no cross-industry technological support facing the decision of putting substantial funds into R&D and product improvement, or getting out of the business. That probably will be true for both Europe and the U.S.

One reason why U.S. producers will face the decision is the mounting federal effort to develop registration standards for biocides. Such standards, similar to the gradient monograph program that the Food & Drug Administration is in the midst of with cosmetic and toiletry-product raw materials, will be established for classes of biocides. One of the major elements of the standards is the data supply on the materials. If there are gaps in the data, someone will have to fill them in, either through group funding of an independent research lab effort, for example, or with one producer doing the work and compensated by other manufacturers and marketers.

That will put even more pressure on some of the older biocides, in particular, which were registered many years ago when data requirements were not so stringent as they are now. If the data haven't been updated—and likely not—there will have to be some serious work done to maintain registrations. If a material is already under fire, for whatever reasons, manufacturers will have to make hard decisions about supporting or abandoning the line, perhaps trimming the number of products in a line to lessen the overall burden.

Until things become more sorted out on the regulatory front, however, the market will continue to be "new"—developed within the past 10 to 15 years—versus old.

The paint industry is perhaps one of the best examples of the marketing battle. Mercurial products long were the accepted standard for preserving both the paint formulation from bacterial spoilage and the dried paint film from mildew attack. They have broad-spectrum activity and are inexpensive. But mercurials have been

Biocides work as fungicides, preservatives, sanitizers

Properly speaking, "biocide" should be the umbrella term used to describe all those products used to kill some form of living organism or tissue. But by a quirk of etymological fate, "biocide" in general has come to indicate a subsection of "pesticide," reserved for products that kill (or, as -stats, control, as in "biostats") microorganisms—bacteria, algae, slime molds, fungi, and viruses.

Depending on the target organism, a particular biocide might be a fungicide, most frequently a mildewcide. Or it might be a bactericide, also often called a germicide, or, in some industries, a preservative. To the cosmetics industry, for example, "preservative" sounds much more socially positive and beneficial than "biocide."

Preservation is, indeed, one of the major reasons industrial biocides are employed. In paints, they are used both to protect the wood substrate under a dried film of paint, and—in latex systems—to protect the formulation itself by preventing spoilage, foul-odor generation, loss of viscosity, and gas formation. That's biocides' function, in fact, for latex or emulsion systems in general, whether for emulsion adhesives, cosmetic and toiletry preparations, polishes,

and inks; for other materials with high or even minimal contamination-level moisture content, including titanium dioxide slurries, resins, metal-working fluids, drilling muds, and fuels; and for materials to be exposed to high-humidity areas.

And, although the consumer side of the biocides industry isn't covered here, biocides are used to preserve swimming-pool systems, preventing growth of algae and slime. The halogens used for pools—iodine compounds, and chlorine-generating compounds such as hypochlorites and chloroisocyanurates—also tackle the other major job of biocides: sanitation.

Whether as disinfectant (usually designating products applied to hard-surface areas—such as floors and walls—and to equipment, killing microorganisms but not necessarily bacterial spores), as sanitizer (implying a cleansing as well as disinfection, and a reduction or destruction of bacteria to safe public-health levels), or as sterilizer (destroying all forms of bacteria, molds, fungi, and viruses), biocides are important agents in promoting health and safety, and well-functioning and attractive products.

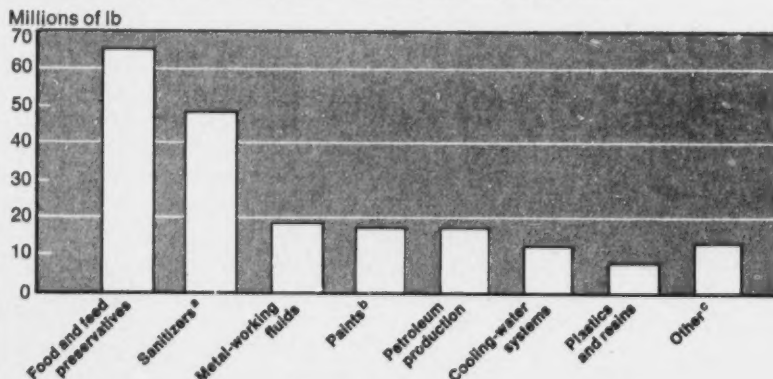
banned by the Environmental Protection Agency from use in paints and coatings, except as preservatives for latex paint formulations, which have the lion's share of the trade sales, or consumer sales, paint market.

Mercurials still have a respectable business in paints, particularly with small paint makers, who see no reason to switch if they aren't forced to. By not switching, they do not have to

tinker with their formulations to produce acceptable products. And they can continue to pay less than 20 cents per lb for biocides, rather than nearly 30 cents for many nonmercurials—oftentimes crucial in an industry whose profit margins can be as low as 1 to 2%.

Producers of nonmercurials have found more fertile ground with larger companies that have abandoned

Many biocide markets are small and specialized



^a For industrial and institutional cleaners. ^b Preservatives, mildewcides, antifoulants. ^c Includes textiles, leather, adhesives, hospital scrubs, and cosmetics.

Business

mercury as a matter of social and political policy. And they are starting to see indications that the newer products can lead to improved paint, both in terms of simpler, more rational formulations, and in terms of length of protection. The mercurials, for example, are water soluble, so eventually leach out of the exterior paint on a house, thereby ending mildew protection. Some of the newer biocides are not water soluble, so don't leach out. That means a paint maker can formulate a product with mildew protection boosted from, say, one year to four or five—a substantial marketing plus.

Similarly, longer life is one of the major selling points of the newer biocides in the marine coatings business. With marine insurers extending the periods between mandatory drydockings for engine overhaul and regular maintenance, coatings makers are being hard pressed to offer extended antifoulant performance to match. Copper oxide systems probably account for about half the business, which is essentially a global business simply because of the peripatetic nature of the substrate—a

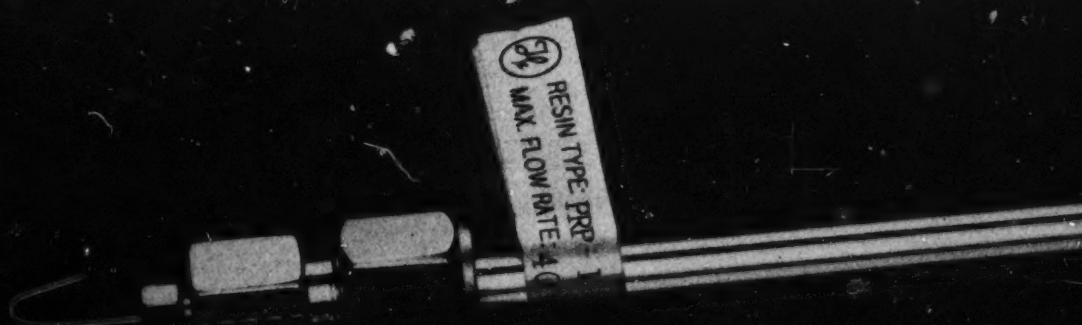


Unprotected rug backing compound (left) shows deterioration caused by microorganisms; compound protected by biocide (right) retains its normal state

ship can be put into drydock anywhere there are facilities and the owner wishes. In fact, the U.S. marine coatings business probably is less than 15% of the total international market, with Europe accounting for 35 to 40% of the business, and the Far East the remainder—40 to 45%, heading toward 50% over the next few years.

However, organometallic technol-

ogy—primarily organotin compounds—is challenging strongly for this business. Copper compounds are sensitive to harbor pollution, some sources indicate, and the leaching mechanism is unpredictable and difficult to control. It's difficult to guarantee for a full two years, which is becoming the standard time between drydockings, with six-month extensions not uncommon.



Introducing a Reverse Phase HPLC Column independent of pH. Now there's a Reverse Phase Resin column designed for sample separations where pH and salt concentrations are of concern. Hamilton's new PRP-1 is ideal for separating polar, semi-polar, and some neutral compounds by HPLC. And its hydrophobic qualities are equal or superior

to any C¹⁸ silica.

Hamilton's PRP-1 is filled with highly rigid 10 μ m macroporous resin spheres which can selectively adsorb both ionic and neutral solute species. These non-swelling adsorbents operate over a significantly broader pH range than conventional alkyl functional silicas. And their physical stability precludes

the need for guard columns or concern for damage to the packing.

The PRP-1's extended pH range accomplished without the use of expensive "Pic" reagents provides a powerful tool in qualitative chromatographic analysis, because protic species can be separated at different pH extremes.

Applications for PRP-1

HAMILTON SEPARATES

Organotin compounds lengthen the life of a copper antifoulant, so they started out as coingredients with copper. But the push lately has been to straight organotins. And recent developments with organotins chemically bound to polymers that are incorporated into paint formulations offer even more promise, as ablatives, self-renewing finishes, giving a controlled "release," or exposure, of antifoulant.

Local regulations are putting some pressure on customers of biocides, perhaps even more than federal requirements. Illinois, for example, has regulations governing mercury discharge in effluent waters so stringent that it effectively knocks out mercury for paints, even for small paint makers.

Similarly, rules such as Michigan's, which limit the concentration of phenolic compounds in wastewater effluent on the ground that they can upset treatment plants, is causing metal-working plants there to switch to other biocides, away from the phenolics. In-use performance, one marketer points out, takes a back seat to ensuring that a plant's effluent

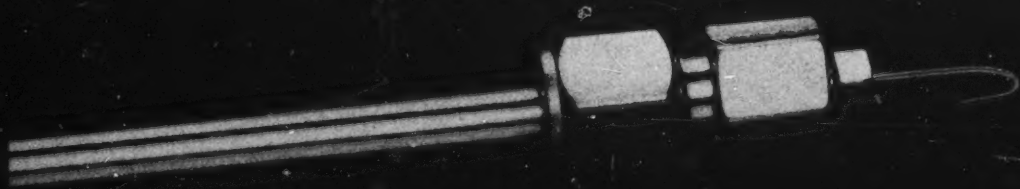
stream is not rejected by a treatment plant.

Phenolics also are under fire on biodegradability grounds, which makes quaternary ammonium compounds increasingly important for disinfectants and sanitizers, in particular. These compounds also have other advantages: They have more water solubility, so are easier to incorporate into cleanser formulations, and they don't have the distinctive odor that phenolics have.

Phenols also have been getting a drubbing in the major area of wood preservation, although environmental agitation about the compounds has not reached the level it has in Europe. Some marketers suggest that European developments may foreshadow events in the U.S., as rising costs and environmental pressures force a shift away from phenols—in particular, pentachlorophenol—and creosote-based products, to more sophisticated biocides. Organometallics are finding favor in Europe, but must be selected carefully, because basic tributyltin oxides, for example, are inactivated by soil contamination, prohibiting their use underground.

And formaldehyde, long a material of choice for many applications, is losing ground as fears of its unhealthful effect mount. Adhesives makers favored formaldehyde because it would volatilize, leaving an adhesive film with no worry about performance being affected. But a combination of bad press and occurrence of formaldehyde-resistant strains of bacteria in some plant lines is forcing a switch to other biocides. It's been a difficult job of selecting and gauging performance, adhesives chemists say, because many biocidal materials are inherently antiadhesive, and so could affect performance adversely.

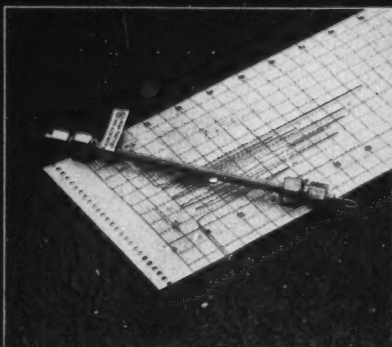
If adhesives makers have had to worry about the effects of incorporating a new biocide into a formulation, biocide makers often have to worry about incorporating new base compounds into the formulations they are trying to preserve. A case in point: metal-working fluids. Traditional oils are being replaced with synthetic formulations, and producers are forced to redesign their preservative systems to handle the new products. □



column include nucleosides, nucleotides, organic acids and bases, drugs, peptides, esters, halogenated phenols, and many others.

And best of all, this extraordinarily efficient 150 mm x 4.1 mm column (22,000 theoretical plates/meter efficiency) is priced at \$225.

When your LC demands are for an exacting, depend-



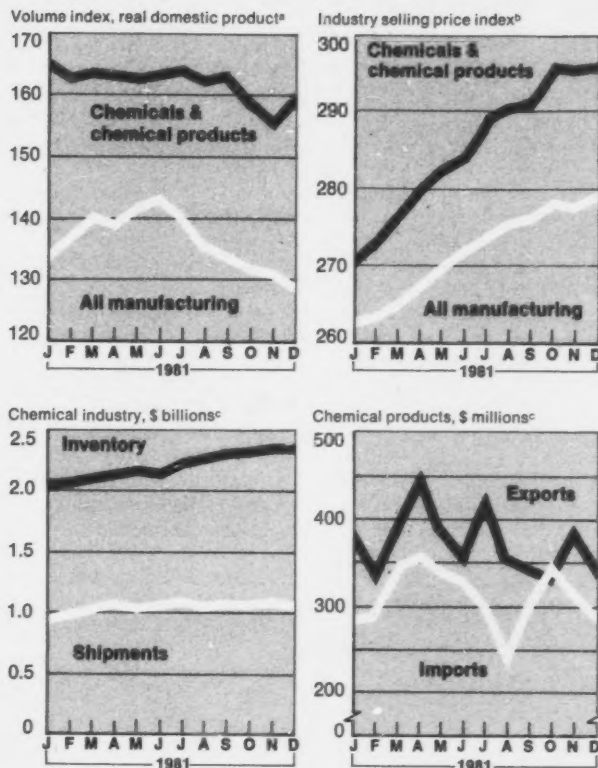
able column, separate the resin from the silicas. The Hamilton PRP-1 Reverse Phase HPLC column. The superior alternate to derivatized silicas.

For further information call toll free 800-648-5950 for the dealer nearest you. Or write Hamilton Company, P.O. Box 10030, Reno, NV 89510.

HAMILTON

THE RESIN FROM THE SILICA.

Severe recession hurts Canadian chemicals



a Seasonally adjusted; 1971 = 100. b 1971 = 100. c Canadian dollars.
Source: Statistics Canada

Only a few bright spots in chemical output

Production, thousands of metric tons	1981	1980	1979	% change 1980-81
ORGANICS				
Ethylene	1330	1197	1014	11.1%
Propylene	677	594	na	14.0
Benzene	566	560	493	1.1
Toluene	480	470	na	2.1
Xylene	410	403	na	1.7
PLASTICS				
Polyethylene, low density	451	439	428	2.7
Polyethylene, high density	223	202	200	10.4
INORGANICS				
Hydrochloric acid	186	177	154	5.1
Nitric acid	861	713	na	20.8
Phosphoric acid, 100% P ₂ O ₅	744	808	748	-7.9
Sulfuric acid	4117	4295	3666	-4.1
Ammonia, anhydrous	2654	2556	2405	3.8
Ammonium phosphate	1355	1468	1336	-7.6
Chlorine	1292	1302	1031	-0.8
Sodium hydroxide	1458	1459	1138	-0.1

na = not available. Source: Statistics Canada

Like a troubled swimmer struggling toward shore, the Canadian chemical industry is striving to ride out a deep recession and make its way to the shallower waters of a better business climate.

It may be a long swim.

Most Canadian economists agree that economic recovery in Canada won't come until the third and fourth quarters of the year. Meanwhile, they are hoping that, when all of the indicators are tallied, they will show that the recession bottomed out in the first quarter. And "flat" is about the best they can do to describe the second quarter.

That means that Canadian chemical companies will be playing it close to the vest for some time to come. The signs already are apparent. Production cutbacks, delays in some construction schedules, and even outright cancellation of some building plans already are cropping up.

One big reason is the red ink that will splatter the bottom line of many chemical company annual reports. Last year started out strong for the Canadian chemical industry. But it fell apart in the second half, particularly in the fourth quarter.

Demand fell, not only in the Canadian market, but in the critically important export market. Price increases were hard to push through and Canadian chemical companies were squeezed by rapidly rising costs. The much higher costs of energy and feedstock were particularly painful.

Through this classic cost-price squeeze, producers in the organics end of the business managed to maintain a fairly healthy level of production and shipments. Ethylene output, for example, was up 11% in 1981 and production of low-density polyethylene rose 10% last year.

Inorganics, however, didn't fare so well. Output of many fertilizer materials and other heavy inorganics was down last year as high interest rates hobbled farmer purchasing in Canada and in the U.S. export market.

The impact on chemical company profits was predictable. From company to company, the story is agonizingly similar: sales up, profits down.

Sarnia-based Petrosar, for instance, pushed its sales past the billion-dollar mark for the first time, up 39% to \$1.2 billion (Canadian). But net income last year fell 19%. Its neighbor Polysar increased sales 14%, yet suffered a 70% plunge in net income.

The combined sales of four other major Canadian chemical companies (C-I-L Inc., Celanese Canada, Du Pont Canada, and Union Carbide of Canada) rose 11.5% in 1981. Combined net income, however, dropped 26% (C&EN, March 1, page 14).

Feeling very uncomfortable with this profit pinch, many Canadian chemical companies are taking steps to correct it. Production is being cut back. Preliminary figures for January bear this out. Output of many fertilizer products was down in January, compared to a year ago. Even many key organics and plastics are facing production cutbacks. Ethylene output was down 3% in January, polyvinyl chloride production was off 14%, and benzene output fell a significant 31%.

Earl Anderson, New York

NOTE

ONLY THE FOLLOWING PAGES OF THIS
PUBLICATION HAVE BEEN FILMED

Cover 1, p. 3, 63-69.
